ENERGY MYTHS

STEPHEN PETERSON
Research Officer
Urban Transport Study Group
of N.S.W.

ABSTRACT: *The turmoil in world oil markets caused by the actions of OPEC in 1973-74 has generated a number of popular beliefs with regard to an impending oil crisis, its impacts on Australia's transport system and the available solutions to Australia's likely oil fuel problems. While most of these beliefs do contain an element of truth, many exhibit a lack of understanding of the issues involved.*

This paper examines some of the most popular misconceptions with regard to Australia's oil fuel outlook, including the belief that:

* *OPEC is completely flexible with regard to oil pricing and would have no reservations about restricting the supply of oil to the western world*

* *An oil crisis will suddenly hit the world in the mid-1980's severely impacting the world's transport systems and life-styles*

* *Australia's large coal reserves will enable it to overcome the problems caused by 'an impending oil crisis' through coal liquefaction*

* *Substantial investment in public transport facilities is warranted on the basis of energy considerations*

It is argued in the paper that a more likely scenario is a gradual adjustment to a changing oil situation brought about by higher energy prices.

The views expressed in this paper are the views of the writer and not necessarily those of the Urban Transport Study Group of N.S.W.

Paper for Presentation in
Session 10

INTRODUCTION

When OPEC quadrupled the price of crude oil in 1973 and imposed a partial embargo on exports it suddenly became apparent to an oil dependent world that the era of relatively low priced and freely available oil had ended. In future it seemed that world oil supply would largely be controlled by the policies of OPEC.

This, in fact, has been the case since 1973 and as a result of its obvious dominance of the world oil market it is widely believed that OPEC can and will manipulate the supply and price of oil at will. It is also widely thought that limits on OPEC production and the lack of alternative sources of oil supply will result in a worldwide continuing shortage from the mid 1980's. This is the basis of the so called 'oil crisis' which is expected to create havoc in western economies within the next few years and has led to predictions of the breakdown of democracy in Australia within 20 years as a direct result of the oil crisis (SMH, 1978 b).

Against this background, and with the knowledge that the motor vehicle consumes about 50 percent of all oil consumed in Australia, the obvious solution to the oil crisis is increased use of public transport. Consequently governments have been called on to invest heavily in public transport facilities as an energy conserving measure.

Another obvious solution in view of Australia's coal wealth is manufacturing oil from coal. This, it is believed, would enable Australia to achieve security of supply with respect to oil hence maintaining the standard of living and avoiding severe balance of payments problems. Consequently governments are also being pressured to promote coal liquefaction (AFR, 1978 d).

The beliefs outlined above appear to be widespread judging from statements published in the press and elsewhere. The purpose of this paper is to examine the basis for these beliefs and to determine the extent to which they are valid.

HOW FLEXIBLE IS OPEC OIL POLICY?

That the world oil market is dominated by OPEC is evident from the fact that in 1976 it controlled nearly 70 percent of the world's known reserves, produced over half of the world's annual crude oil output and was the source of over 80 percent of the world's oil exports (AIP, 1977). Consequently there is a general belief that OPEC is in a position to impose virtually any price it wishes and/or restrict the flow of oil to the western world for economic or political motives. Some of the economic motives which have been advanced to support this hypothesis include the argument that OPEC will restrict production due to the difficulty of finding suitable investment opportunities for its oil revenue and also to fuel its planned heavy industries. OPEC demonstrated its willingness to use its oil wealth for political purposes in 1973.

One comment which can be made about this hypothesis is that any producer of any commodity is in a position to restrict his production and/or increase his prices indiscriminately. However the threat of almost certain bankruptcy prevents this course of action. Therefore in relation to OPEC and the world oil market the issues which need resolution are the extent to which OPEC is likely to embark on such a course of action and, if it did, to what extent would OPEC suffer the consequences. The two issues are interdependent.

To begin with, consider the situation that existed prior to October 1973. All through the 60's and up to February 1971 the posted price of Saudi Arabian marker crude was US$1.80/bbl (although the average price received per barrel rose from US$0.7 to US$1.13) and increased to US$2.89 by 1973, (Petroleum Economist, 1978). OPEC members over this period pressed for, and gradually achieved, higher revenues and greater control of oil production. Although the OPEC members did require funds to develop their economies at this time a sudden increase in the rate of capital inflow of the order of 400 percent could not have been put to immediate use. In fact disposing of the funds profitably would have been difficult, which later proved to be the case. In addition the price increase itself would have been more than enough to offset the revenue affect of the partial embargo. Consequently OPEC had no immediate use for the generated funds.

At the same time OPEC recognised the opportunity to use its oil wealth for political purposes in relation to the Arab-Israeli War of October 1973. The embargo then could be used to achieve both political and short term economic objectives simultaneously, without adverse side effects.

Since October 1973 the situation has changed greatly. OPEC is no longer in a position where it can pursue policies adverse to the rest of the world and not be affected itself. The extent of the impacts on OPEC economies will give some indication of the likelihood of OPEC imposing export embargoes in the future.

Since 1973 OPEC economic policy in two major directions has substantially reduced the efficiency of the 'oil weapon' from the OPEC viewpoint. Firstly, given the huge surplus revenues accruing each year OPEC as a group have invested heavily in western oil dependent economies. Secondly most of the OPEC member states are using their oil wealth to industrialise their economies (AFR, 1978 f). Both policy directions have resulted in a significant and continuing interdependence between OPEC and the oil dependent western industrial economies.

In both 1974 and 1975 the OPEC financial surplus was of the order of $US55 billion, however the disposition of these funds changed significantly (Argy, 1976). In 1974 over 70 percent of the surplus was invested in risk free liquid investment, over 50 percent alone were in bank deposits in the United States, United Kingdom and Eurocurrency markets.

In 1975 there was a shift away from destabilising short term commitments into less liquid longer term investment. In the first half of 1975 only 32 percent of the surplus was invested in bank deposits and 45 percent in risk free liquid investments. Since the most profitable investment opportunities were generally in OECD countries OPEC consequently built up a large non liquid investment portfolio in western economies.

To maintain the value of these investments would require stable economic conditions in the western world, particularly the United States, and a stable if not appreciating US dollar, since the majority of oil settlements are in US dollars.

Consider the consequences flowing from a decision by OPEC to either restrict supply of oil or impose unjustified price increases. The immediate impact of such a move would both depress the value of the US dollar and set in motion an economic recession which would spread throughout the western world. The impacts on OPEC would be fourfold. Firstly the value of their US dollar assets would decline, secondly the earning potential and hence value of other investments in the western world would decline, thirdly the depressed economic conditions would restrict demand for OPEC oil hence reducing its revenue(1) and finally the action would further stimulate a move to non-dependence on OPEC oil through fuel substitution and expanded exploration. It can be readily observed that such a move would have political and economic consequences which would conflict with the other major policy, that is the industrialisation of OPEC economies.

Industrialisation has four basic requirements - capital, technical expertise, other non labour resources and markets. In recent years some OPEC members have become dependent on large oil revenues to maintain their programme of industrialisation. In fact the days of huge surplus revenues are thought to have ended. It was announced recently (AFR, 1978 m) that OPEC countries were suffering from lack of revenue and that deposits in international banks were falling at a relatively rapid rate, (6.3% in the 6 months to January 1978 to June 1978). In addition many of the ambitious industrialisation projects were being put behind schedule and some were in jeopardy due to lack of finances. Any further revenue cutbacks would have serious consequences for many of these projects.

In addition to revenue, OPEC needs the technical expertise and other resources of the western world to carry out its industrial development programme just as it did to develop the oil industries of its members in the 50's and 60's. Any reluctance to trade its oil for these requirements would seriously hamper the earning potential of its heavy industry which will be required to take the place of oil as a source of foreign exchange upon its decline. Finally, OPEC members will need markets for their industrial output if their industries are to provide the required foreign exchange as their oil reserves run down. The situation could arise where access to markets was tied to the availability of OPEC crude oil.

---

1 Revenue is now needed to continue the industrialisation programmes implemented since 1974.

It should be clear that the interdependence of OPEC and the western world has reached an advanced stage. This fact together with the desire of OPEC to protect its market in the long term from alternative fuels indicates that OPEC would probably be unwilling to impose an embargo or an unjustified price rise. It is also possible that development of reserves in Mexico and China and the stimulus given to oil exploration and oil conservation as a result of OPEC action in 1973 may restrict OPEC's ability to control world oil markets. These issues are discussed below.

WILL THERE BE AN OIL CRISIS?

The term oil crisis generally conjures up images of rapid oil price rises and restricted oil supply similar to the events of 1973-74. However if it is accepted that artificial constraints on supply and unjustifiably high prices are unlikely, as argued above, then the price and supply of oil will be determined by more conventional market forces. The issue at stake then is to what extent market forces will produce a crisis situation.

First of all consider the existing market situation. In December 1976 estimated recoverable reserves of crude oil were 644 billion barrels.[1] At the same time world demand was roughly 21 billion barrels and growing at a rate of five percent per annum. Oil deposits whose recovery is either uneconomic or not possible under existing technology is of the order of three to twenty times this amount (Chapman, 1977).

At the current time there is a surplus of oil on the world market due to increasing production from the North Sea, the coming on-stream of Alaskan oil and the generally slow growth of demand due to slower economic growth over the past few years. These conditions have been forecast to last into the early 1980's (CIA, 1977) so that in the short term oil should be freely available[2] and there should be little pressure on real prices (Folie and McCall, 1978). But what of the longer term situation?

The real limit on oil supply is productive capacity rather than available oil reserves. Given that OPEC is the source of over 80 percent of world oil exports OPEC productive capacity is the crucial element in world supply. In 1976 underutilisation of OPEC productive capacity was estimated to be 9.5 mb/d with plans to increase capacity by a further 6.5 mb/d (OECD, 1977) to 45 mb/d by 1985. By 1990 the Shell Oil Co. (US) (Associated Octel Co. Ltd., 1978) has forecast that world productive capacity would be between 90 mb/d and 100 mb/d which would be enough to accommodate demand growth of between 3.25 and 4 percent per annum.

But even with these planned extensions it is often argued that due to declining production of oil from existing fields the OPEC expansion will not be enough to accommodate world demand. These forecasts are invariably built on fairly rigid assumptions with respect to available economic reserves, advances in technology which increase the resource base and the rate of consumption growth, and have not adequately taken into account the changing market situation brought about by OPEC actions in 1973 and 1974.

---

1 This figure excludes the major part of projected Mexican deposits.

2 This excludes the affects of any unforeseen developments such as the turmoil in Iran.

The increased cost of crude oil has had three major impacts on supply. The immediate impact of quadrupling the price of oil was to greatly increase the known and economically recoverable reserves. For example the North Sea and Alaskan oil fields could not have been profitably developed if OPEC had not increased the price of oil to over US$12/bbl.

Recent èxperience in Bass Strait adequately illustrates the point. Originally, production from the Bass Strait fields was expected to begin declining in 1979. In September 1977 the estimated reserves were reviewed in the light of the move to world parity pricing[1] which increased reserves by 380 million barrels or 15 percent (SMH, 1977). This stalled the expected decline of production until 1982-83. In March 1978 it was announced that reserves had been lifted by a further 250 million barrels or 10 percent by the proposed development of the Cobia and West Kingfish fields (AFR, 1978 g) which would further stall the decline to 1984. It is also currently thought likely that further discoveries of commercial deposits could stall the decline until 1990 (AFR, 1979 e).

The reason for the renewed optimism is that the higher oil price has dramatically reduced the size of deposit which can be commercially exploited. This leads to the second major impact which is the boost to exploration activity dating from the decision announced in the 1975 budget speech to pay world parity prices for all 'new' oil.[2]

Prior to this decision exploration activity in Australia had fallen from 215 test wells drilled in 1970 to a low of 21 in 1976 and 1977 (Aust., 1978 a). Since then exploration activity has gradually picked up. In 1977-78 expenditure increased 61 percent to $116 M which included a 41 percent increase in drilling depth (AFR, 1974 j). Exploration commitments over the next 5 years already exceed $400 M (AFR, 1978 l), and it is estimated that 143 wells will be sunk in 1979 (Aust., 1978 a). Most is expected to be spent on the North West shelf and on development of Bass Strait although there has also been a move back onshore where under the present price structure fields in the range of 5-10 million barrels can be commercially exploited (AFR, 1978 a, AFR, 1978 b).

The further development of Bass Strait has already yielded results with the recent discovery of the Fortescue field. To date the size of the new field is expected to be of the order of 300 million barrels. The discovery came after Esso and BHP had publicly stated that the chance of finding a field of such magnitude in Bass Strait was remote (AFR, 1978 n).

Internationally, the escalation of Mexico's reserve figures has been nothing short of spectacular. In December 1976 Mexico's proven reserves were raised from 6.3 to 11.16 billion barrels (Economist, 1977). By the end of 1977 the figure had climbed to 16 billion barrels with probable reserves at 29.2 billion barrels and possible reserves at 120 billion barrels (Economist, 1978).

---

1 Announced in the budget speech August 1977.

2 Oil discovered after September 18, 1975.

Then in September 1978 the figures were revised again to 20 billion, 37 billion and 200 billion for proved, probable and possible reserves respectively (AFR, 1978 h). Then in October 1978 the director of Pemex, Mexico's national oil company, put possible reserves at 300 billion barrels (Aust., 1978 b) - twice the magnitude of Saudi Arabian reserves. Plans are already well developed to increase production from 1 mb/d to 2.5 mb/d by 1980. Given the proximity of the US market, the largest single importer of oil, and the capital needed by Mexico to invest in itself, the prospects for further increases in productive capacity seem reasonably bright.

Another highly prospective area which has only recently come to light is China. Estimates of reserves range up to 100 billion barrels. That these figures do have some factual basis is indicated by the procession of international oil companies to Peking seeking exploration permits (AFR, 1978 k).

In addition to conventional sources of oil the world's shale oil reserves are known to be massive with estimates of the total resource base being 168 trillion barrels (OECD, 1975). Canada's Athabasca tar sands have the potential to yield 300 billion barrels alone. It has also been argued by Herman Kahn that the cost of shale oil would be competitive with current oil prices (AFR, 1978 n).

It would appear then from recent developments that there is indeed plenty of oil left to be commercially exploited and the increased price being paid for crude oil has proven to be the stimulus required for exploration and development.

The third area of impact of higher oil prices relates to the technology of recovery. Higher prices mean that secondary and tertiary methods of recovery can be used economically to increase the percentage of oil recovered from a deposit. Generally only about one third of the oil in a deposit has been recovered. It has been estimated that in the United States at current world prices the use of advanced recovery techniques could yield up to 29 billion barrels hence doubling the proven recoverable reserves of the United States (US Dept. of Energy).

The final area of impact is on the demand for oil. Short term impacts are generally expected to be minor due to ingrained behavioural patterns and institutional barriers to conservation measures and substitute fuels. However in the long run the impact should be significant.

Conservation programmes have been implemented in most of the major western economies. For example automobile fuel economy standards implemented in the United States and Canada are expected to double the efficiency of motor vehicles by 1985. In addition to this there are a multitude of other measures in the US programme covering all modes of transport. The payoff from these programmes by the target year 1985 is expected to be large. In the United States the total transport fuel savings are estimated to be around 1.2 billion barrels per year (US Dept. of Transport, 1978). The rate of growth of United States oil consumption is expected to fall to a maximum of 2.3 percent per annum up to 1985 (Associated Octel Co. Ltd., 1978). In Canada the savings are estimated to be about 115 million barrels per year.

In addition to government imposed conservation measures it has been argued by some, that the slower economic growth evident in recent years is a long term phenomena which will greatly reduce demand for energy, particularly oil.

The higher oil prices have also stimulated research and development of alternative fuels and alternative technologies. In the United States goals have been set for alcohol and synthetic oil fuels to reach the fleet testing stage by the early to mid 1980's. Fleet testing of electric vehicles is due to begin in 1979. Market penetration of electric vehicles is forecast to reach 5 percent by 1995, 15 percent by 2000 and 35 percent by 2005 (US Dept. of Energy, 1978).

The discussion above indicates that OPEC actions in 1973 have resulted both in greatly expanded reserves of oil and reduced growth of demand for oil fuels. Rather than result in a 'crisis' this has effectively provided both the time and the stimulus for a phased transition to alternative fuels.

IS COAL LIQUEFACTION THE ANSWER?

Based on speculation of what falling indigenous oil reserves would mean for Australia, coal liquefaction is widely proclaimed as the answer to Australia's potential problem. Coal liquefaction it is argued would enable Australia to remain relatively self sufficient in oil and would avoid the need to pay billions of dollars per annum for oil imports.

To begin with it must be asked whether self sufficiency is a worthwhile goal. In a perfect world economic theory tells us that a nation should specialise in the production of goods in which it has a comparative advantage over other nations. Australia therefore would be better off directing its resources into high valued exports such as uranium, LNG and coal, and import oil. Such a situation may in fact produce a better result on balance of payments. It is interesting to note that a recent discussion of the Australian economy (Brain and Gray, 1978) up to 1985 has forecast an improved balance of payments situation, despite assuming a 300 percent increase in oil imports. This is due mainly to the forecast strong growth of mineral exports over the period.

Consequently increasing the imports of any particular commodity does not necessarily indicate a balance of payments problem. Even if there is a slight problem prices and exchange rates will adjust to the changing circumstances. However it has been pointed out (Folie, 1978) that such adjustments are not costless and it is the costs of adjustment which are important rather than the cost of increased oil imports.

Therefore attempts to maintain or increase self sufficiency in oil are not necessarily justified by the prospect of increasing oil imports. However given that the world is not perfect self sufficiency may be justified on the basis of maintaining security of supply. Consequently coal liquefaction should be evaluated from the viewpoint of maintaining security of supply. Some indication of the likely extent to which coal liquefaction achieves this objective can be gained by examining the problems which need to be overcome prior to its implementation. These can be broadly categorised into technical, economic, environmental and political.

The technology of converting coal to oil was developed in the 1930's in Germany and is well known, although the SASOL plant in South Africa is the only commercial plant in operation in the world. However most of these well known methods have poor conversion ratios and in recent years there has been much research into new techniques to increase the yield of oil

The real technical questions which remain unanswered today relate to the construction of common equipment required in a large scale conversion plant such as slurry pumps, pressure let down systems, solid disposal systems, etc. to enable the handling of 100,000 tonnes/day of coal/oil slurry at high temperature and pressure (Keith, 1978).

The technical problems should not prove too difficult to overcome. However it may still take 15 years or so to construct and evaluate large scale pilot plants and then to construct a commercial plant.

The economic problems are slightly more forbidding. The optimal size of a coal liquefaction plant is generally thought to be of the order of 100,000 barrels per day. Estimates of the capital cost of such a plant range from \$1500 M to \$3000 M although the Australian Coal Industry Research Laboratories put the figure between \$2500 M and \$3000 M (SMH, 1978 c). Australia currently imports over 200,000 bbl/day and this is estimated to increase to over 700,000 bbl/day by 1990. On these figures then, Australia would need to find up to \$20,000 M by 1990 to invest in liquefaction plants if it were to achieve total self sufficiency by 1990. A large proportion of this would necessarily come from foreign sources which could add up to \$2000 M per year to Australia's foreign exchange requirements for repayments.

For synthetic oil to be competitive with natural oil it is estimated that world oil prices would need to rise to between \$20 and \$25 per barrel. (Keith, 1978; SMH, 1978 c). However one factor generally neglected in the calculation of a breakeven oil price is that if oil prices increase it is almost certain that the whole structure of energy prices will increase, especially coal. Hence the breakeven price itself will increase. The rise in the breakeven price will depend on the rate at which coal prices increase due to the increase in the price of oil and on the impact of coal prices on the cost of synthetic crude.

The extent of the likely coal price increase due to an increased oil price is indicated by the events of 1973. The average value of coal exports F.O.B. from Australia in 1973-74 was \$12.5/tonne. In 1975-76 this had risen to \$35/tonne and was largely attributable to the increase in the price of oil (JCB, 1976). The corresponding rise in the world price of oil was from \$3 per barrel to \$11.5 per barrel. The percentage increase in the price of coal was 75 percent that of the oil price increase.

The price of coal is estimated to account for 40 percent of the cost of synthetic crude oil (Shell Co., 1978) for prices in the range of interest. Consequently the breakeven price for synthetic oil will increase by 0.3 percent[1] for each percentage point increase in the world oil price. Therefore whereas the breakeven price was estimated to be in the range of \$20 to \$25 per barrel, if the impact on coal prices is accounted for the real range is more likely to be \$26 to \$41 per barrel. World oil prices would need to increase by a factor of between two and three before coal liquefaction became competitive with natural crude oil.

---

1 Based on 0.75 x 0.4 = 0.3.

If coal is made available to coal liquefaction plants at less than its real price in an effort to make synthetic crude oil competitive with natural crude oil this will mean that the production of synthetic crude is being subdised by the Australian community. This misallocation of resources will effectively reduce national income which may be regarded as the price of security of oil supply.

The costs involved with liquefaction do not stop at this however. The cost involved in expanding the coalmining industry and its associated infrastructure will itself be a large sum. Estimates of the requirement for coal vary but generally a figure in the region of 20 million tonnes per year for each 100,000 barrels per day plant is considered reasonable. In 1977-78 total production from the Hunter Valley in N.S.W. amounted to only 29 million tonnes, not enough to substitute for current oil imports. Total Australian coal exports in 1977-78 were 38 million tonnes, enough to support two plants but again not enough to substitute for current oil imports. In fact total output of the Australian coal industry in 1977-78 was 80 million tonnes enough to support only four liquefaction plants. These figures should illustrate the required expansion of the coalmining industry when the oil supply gap is estimated to increase from its current level of 220,000 bbl/day to over 700,000 bbl/day by 1990. Up to 140 million tonnes per annum would be required to achieve self sufficiency. Industry output would need to increase by over 200 percent. The cost of such an expansion, assuming suitable deposits of coal exist would be of the order of $10,000 M or roughly $1250 M for each plant.[1]

In addition to the capital requirement the requirement for skilled manpower could also impose a limit. The industry workforce would need to be expanded by between 12,000 and 50,000 on current rates of productivity, depending on the proportion of coal mined using open cut techniques. Given that the industry currently employs about 25,000 it may be a difficult task to recruit and train the required manpower before 1990.

Coal transport costs at roughly 75 cents/tonne-kilometre, or $15 M per year for each kilometre between plant and mine make the location of the plant near the mine desirable. However liquefaction requires huge volumes of water both in the process and for cooling. Finding suitable locations which balance these two locational requirements could prove difficult and add further to the cost.

The environmental impact associated with the open cut mining of 140 million tonnes of coal per year needs no elucidation here although restoration is possible at a cost. However probably the most significant environmental aspect is the continued use of hydrocarbon fuels when the chance to change to an alternative such as alcohol, most likely at no extra cost, has presented itself. Again the environmental impacts of hydrocarbons have been well documented and need not be repeated here.

1 These estimates are based on the estimated cost of development of Utah's Norwich Park deposit (AFR, 1978 i) and Atlantic Richfield's proposed development of the Blair Athol deposit (SMH, 1978 a).

The political aspects of liquefaction are also likely to produce difficult problems. Given the somewhat uncertain economics of liquefaction and the huge investment required, it is unlikely that liquefaction will ever be highly profitable. Consequently with the risk involved the private sector would need government support in the way of guaranteed minimum price and market before proceeding. It is also likely that the government would need either to provide part of the capital or guarantee any loan funds required.

Government assistance to the highly profitable oil industry is not likely to be easily accepted by other less profitable industries. Similarly the expansion of coalmining and the continued use of hydrocarbon fuels is not likely to be easily accepted by conservationists or environmentalists.

It should be clear from the discussion above that as a means of providing security of supply coal liquefaction is unlikely to be effective, particularly in the period up to 2000. In addition the previous sections of this paper cast some doubt on the need for an alternative source of oil supply up to 2000. After 2000 the likely market penetration of electric vehicles reinforces this doubt. To embark on a programme of coal liquefaction at this time would seem to be an extremely high cost solution to an uncertain problem.

IS PUBLIC TRANSPORT THE ANSWER?

The most obvious solution to the energy crisis is seen by many to be greater use of public transport. Consequently the energy crisis has been interpreted by some to warrant large investment in public transport facilities. This line of argument rests on two premises; firstly that public transport is more energy efficient than the car and secondly that the increased cost of oil will be sufficient to change travel patterns. The argument therefore depends on the extent to which these two premises are valid.

Estimates of energy efficiency of passenger transport modes are shown in Table 1. The figures indicate that buses are the most energy efficient followed by rail with cars being the least efficient.

Table 1

Energy Efficiency of Passenger Transport Modes

(kJ/pass. - km)

Mode	Efficiency
Car	2100
Bus	800
Train	1800

Source: Nicholas Clark & Associates, Transport and Energy in Australia: Part 2 - Consumption by Categories. A report prepared for the Bureau of Transport Economics, August 1975.

Some authors in recent years have drawn attention to the fact that considering only the direct energy consumption ignores a significant amount of energy used by the infrastructure associated with each mode. They therefore argue that this indirect consumption should be included in energy efficiency calculations. But for the purpose of this paper it should be remembered that it is only the prospect of a liquid fuel shortage which causes concern and public transport facilities are to be evaluated from the point of view of conserving oil based fuels. The majority of the indirect energy used by the infrastructure is electric based and is not relevant to this discussion and secondly much of the energy used by infrastructure is not avoidable and would not necessarily be reduced if there was a significant shift to public transport. Therefore only direct energy consumption has been considered here.

To begin the discussion consider first of all the reasons why the figures in Table 1 should be as they are. Firstly public transport is only a profitable undertaking when the service is provided either in a high volume corridor or between points of significant trip generation or attraction. Therefore public transport services mainly operate under the most suitable conditions in time and space in an attempt to maximise their loadings and profitability. For example, in Newcastle about 45 percent of weekday PTC bus services operate in the peak periods (6 a.m. to 9 a.m. and 3 p.m. to 6 p.m.). For privately operated buses the figure is 63 percent. The average loading on buses at Broadmeadow in the peak in the major direction is 34 while on the remainder of services the average loading is 13.(1)

Secondly the method of calculating energy efficiency does not adequately reflect the efficiency of various modes. The car provides a door to door service by the most direct route known by the driver. Efficiency is therefore calculated on an origin destination basis. Public transport services operate on fixed routes which do not necessarily relate to origin or destination and are generally circuitous. Although energy consumption per passenger mile may be less than for cars, public transport patrons often travel further than they would if they had travelled by car. Investigations carried out at UTS have indicated that travelling by public transport can often by 30 percent longer than by car for the journey to work.

In terms of the energy efficiency of various modes between two points the figures in Table 1 may be misleading. If public transport facilities were expanded it is likely that fuel savings would be further reduced for the following reasons.

Firstly the introduction of better or more services would tend to generate trips which otherwise would not have been made. Secondly new facilities would draw patronage from existing facilities rather than car passengers only. For example a large portion of the patronage on the eastern suburbs railway is expected to come from existing bus services.

1 PTC bus passenger counts.

Finally and perhaps the most important point is that if public transport was to provide a suitable alternative to private cars services would have to be provided at off-peak times in low volume corridors and to places with relatively low trip generation and attraction potential. Consequently load factors would decline and energy efficiency would worsen. While the net impact on the relative efficiency of modes is unclear it is certain that the private car is nowhere near as inefficient as the figures in Table 1 imply.

In addition to this the Federal Chamber of Automotive Industries (FCAI, 1978) have undertaken to reduce the fuel consumption of new cars by 15 percent by 1983 and 20 percent by 1987 which further reduces the efficiency difference between cars and public transport.

The second premise is that travel patterns can be changed to include a higher usage of public transport facilities. However travel by public transport in most cases is inferior to car travel. Cars provide door to door service, are generally more comfortable, allow the tripmaker to travel where and when he desires and tripmakers have constantly shown a preference for cars above public transport.

Under these circumstances travel patterns are only likely to change due to a cost advantage in favour of public transport. NRMA estimates for the cost of operating a medium sized vehicle are approximately 4.8 cents/km. However it has been suggested that the perceived cost of motoring is only of the order of two thirds of the fuel cost (Brown) or roughly 2.7 cents/km.

Public transport fares for the Sydney metropolitan area are shown in Figure 1. For all trip lengths the fares are generally many times more than the perceived cost of motoring and this makes no allowance for the circuity of public transport routes. Even though the perceived cost of motoring will increase in direct proportion to any increase in petrol prices there are two offsetting factors. Firstly increased fuel costs will lead to increased public transport fares albeit at a lower rate and secondly improved efficiency of motor vehicles will reduce the perceived cost of motoring between any two points. It is likely that the price of oil would need to rise astronomically before travellers chose public transport in preference to cars of their own free will.

Governments could consider holding public transport fares below the cost of motoring but this is likely to prove impractical since private bus operators would need massive subsidies to maintain their operation and large deficits on government owned operations could be politically embarrassing.

The scope for altering the mode split is also restricted by the proportion of trips which are just not suited to public transport. Over 21 percent of daily vehicle passenger trips are either business trips or 'paid' work trips, neither of which are likely to switch to public transport regardless of cost. Nearly thirty percent of daily vehicle passenger trips are for personal business,social or shopping purposes and are less than 5 kilometres in length (Peterson, 1978). For trips of this length the cost of public transport is at least three times the perceived cost of motoring. Therefore roughly half of daily vehicle passenger trips must be rated as most unlikely candidates for public transport.

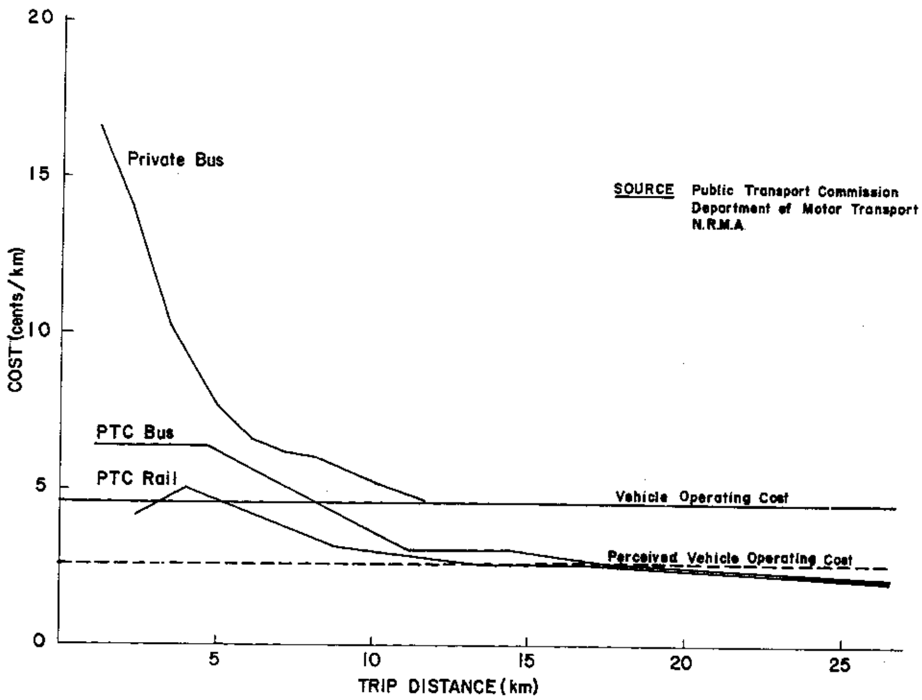

FIGURE I

SYDNEY METROPOLITAN AREA PUBLIC TRANSPORT FARES

The arguments above are supported by the findings of several studies. The Australian Transport Advisory Council (ATAC, 1978) estimates that increasing the public transport share of the urban passenger transport task from 15 percent to 23 percent would save only 1 percent of fuel at most.

Studies in the United States (TRB, 1978) have come to a similar conclusion that modal shifts offer little potential energy savings at an extremely high cost with a low chance of success. There it is estimated that by 1990 energy savings could amount to 0.8 percent at a cost of US$6 billion with a low chance of achievement. In comparison over the same period it is estimated that fuel savings could amount to 15 percent at a cost of US$0.05 billion with a high chance of achievement through modest 'off-the-shelf' improvements in vehicle technology. More advanced technology could save 32 percent at a cost of US$5 billion. As a means of conserving oil, it must be concluded that investment in public transport facilities is clearly inefficient.

CONCLUSION:

The sudden wealth of OPEC and subsequent efforts to industrialise the economies of member countries has created a state of interdependence between OPEC and the western world. This has greatly reduced the flexibility of OPEC with regard to it's oil policy since, for its own good, it needs to feel some concern for the economies of western nations.

The emergence of OPEC as a major force in world economics and politics has stimulated efforts by western nations to both reduce their dependence on OPEC oil initially and secondly to reduce their dependence on oil itself. For these reasons the likelihood of a world oil crisis appears to be remote unless caused by unforeseen circumstances such as the current unrest in Iran.

In this situation it would be undesirable to outlay the large sums required to establish a coal liquefaction industry since the need for it remains unproven and its effectiveness in securing supply is doubtful. In addition to this it is most likely that it would result in an inefficient one of Australia's resources.

Similarly substantial investment in public transport facilities is unlikely to be effective in curbing the demand for oil fuels and, as with coal liquefaction, would probably result in an inefficient allocation of resources since there are a number of more cost efficient methods of reducing consumption of oil fuels particularly improvements in motor vehicle technology.

REFERENCES:

Australian Financial Review, January 10, 1978 a

Australian Financial Review, February 1, 1978 b

Australian Financial Review, March 1, 1978 c

Australian Financial Review, March 3, 1978 d

Australian Financial Review, April 19, 1978 e

Australian Financial Review, April 27, 1978 f

Australian Financial Review, April 27, 1978 g

Australian Financial Review, October, 6, 1978 h

Australian Financial Review, October 13, 1978 i

Australian Financial Review, October 23, 1978 j

Australian Financial Review, November 1, 1978 k

Australian Financial Review, November 2, 1978 l

Australian Financial Review, December 12, 1978 m

Australian Financial Review, December 22, 1978 n

Australian Institute of Petroleum Ltd. (1977) Oil and Australia - the figures behind the facts.

Argy, V. (1976) The Effects of the Higher Oil Price on the World Economy. Macquarie University School of Economic & Financial Studies, Research Paper No. 106, April 1976.

Associated Octel Company Ltd. (1978). Information about the oil industry for the oil industry, Vol. 18, No. 2.

Australian Transport Advisory Council, (1978). Transport and Energy Overview.

Brain, P.S., and Gray, B.S. (1978). The Medium Term Prospect for the Australian Economy, 1978 to 1985. The Australian Economic Review, 3rd Quarter 1978.

Brown, H.P., Issues in the Specification of Policy Sensitive Models of Mode Choice, unpublished.

Chapman, R.G., (1977). Energy Resources and Transportation, Electric Transport Conference 1977, Papers and Proceedings.

CIA (1977). The International Energy Situation: Outlook to 1985.

Economist, March 28, 1977
Economist, April 22, 1978

Federal Chamber of Automotive Industries, (1978). A Uniform Code of Practice for Passenger Car Fuel Consumption Reduction, June 1978

Folie, M. (1978). An Analysis of the Policy for Developing Australia's Oil Reserves, The Australian Quarterly, Vol.50, No. 3.

Folie, M. and McColl, G.D.,(1978). The International Energy Situation Five Years After the Opec Price Rises, CAER Papers, No. 5

Joint Coal Board, 29th Annual Report 1975-76

Keith, Norm, (1978). Coal Hydrogenation, BHP Journal January 1978

Nicholas Clark & Associates (1975). Transport & Energy in Australia Part 2 - Consumtpion by Categories. A report prepared for the Bureau of Transport Economics, Occasional Paper No. 2

OECD (1977). World Energy Outlook
OECD (1975). Energy Prospects to 1985

Peterson 1978, the Economics of the Energy Problem. Australian Institute of Urban Studies, Seminar The Impact of the Impending Oil Crisis on Sydney's Travelling Public, February 1978.

Petroleum Economist, January 1978

Shell Company of Australia Ltd. (1978). Coal Conversion Economics, April 1978.

Sydney Morning Herald, September 28, 1977
Sydney Morning Herald, October 12, 1978 a
Sydney Morning Herald, November 16, 1978 b
Sydney Morning Herald, December 16, 1978 c

The Australian, December 22, 1978 a
The Australian, December 22, 1978 b
The Australian, January 25, 1979

Transportation Research Board, (1977). Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation, National Co-operative Highway Research Program, Synthesis of Highway Practice, 43.

U.S. Department of Energy (1978). Environmental Development Plan, Transportation Energy Conservation FY 1977. March 1978, DOE/EDP-0018

U.S. Department of Transportation (1978). Energy Conservation in Transportation. May 1978

U.S. Office of Technology Assessment (1978). Enhanced Oil Recovery Potential in the United States. January 1978. OTA-E-59.